

Research Article

Notes of Some Macroscopic Fungi at IPB University Campus Forest: Diversity and Potency

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Abstract

Macroscopic fungi are cosmopolitan-heterotrophic organisms that have an important ecological role in the ecosystem. This study aimed to explore the diversity of species and the potency of Fungi in the Campus Forest of IPB University. The observation was carried out from March to April 2019 using the exploration method. Identification used morphological characters such as fruit body shape, hygrophanous, cap color, diameter, edge, and margin, wetness level, hymenophore type. The result showed that all identified fungi were Basidiomycota, 11 individuals, which was divided into 7 families, 4 order, and 1 class. The Group fungi were identified as *Termitomyces* sp. 1, *Termitomyces* sp. 2, *Marasmius* sp. 1, *Marasmius* sp. 2, *Psathyrella* sp., *Geastrum* sp., *Stereum* sp., *Microporus* sp., *Polyporus* sp., *Ganoderma* sp. 1 and *Ganoderma* sp. 2. Some fungi found to be potentially used as food sources, medicine and also played an important role as a decomposer in the IPB university campus forest.

Keywords: Diversity, Potency, Macroscopic Fungi, Campus Forest, IPB University

1. Introduction

Macroscopic fungi are a group of fungi that have a fruiting body that can be seen by the eye without a microscope. Macro fungi are mostly members of Basidiomycota and Ascomycota (Hibbett et al., 2007; Mueller et al., 2007). The great variety of mushroom species, similar shapes, and colors, are the constraints to identify them based on macroscopic characters. According to (Putra et al., 2018), the types of hymenophore can be a quick parameter and are the main identification characters for macro fungi, including lamella, pores, teeth, and glebe. In addition, types growing substrate such as leaf litter, dead trees, and soil are also a key point in describing mushroom. The growth substrate is an important aspect of mushroom development since they need to find a suitable substrate for growth with sufficient cellulose, lignin, and carbohydrate sources, which are used as a source of nutrition (Rahmawati et al., 2018).

Mushrooms are interesting organisms, both in the term of their diversity and potential utilization. Studies on macroscopic fungi and their utilization have gained significance during the decades in Indonesia. Inventory of mushroom diversity is the first step in efforts to use it. The use of mushroom resources around educational institutions as material for the dissemination of knowledge (lecture and practicum) is one of the answers to the challenges of the development of mycological science in Indonesia. From a mycological science point of view, the diversity of Indonesian macro fungi is broadly unknown and poorly understood. The author provides most of the

information regarding the diversity and utilization of macrofungi in temperate regions (Hawksworth, 2001; Mueller et al., 2007; Lonsdale et al., 2008).

There are still many species of mushroom in Indonesia which have not been described and recorded properly, and campus forest is no exception. To date, the diversity of mushrooms in the IPB University campus forest (IPBUCF) area has not been well recorded. The condition of IPBUCF is dominated by trees so that many litters rot on the forest floor. The vast campus forest and high rainfall create a suitable place for mushroom development. The purpose of this study was to examine information about macroscopic fungi diversity at the IPBUCF so that it can become a reference for information on its potential use in the future.

2. Material and Method

The study was conducted at IPBUCF in March-April 2019 (Figure 1). Data collection was done by exploration method referring to Puspitaningtyas (2007) and Irsyam and Priyanti (2016). Mushroom identification was carried out using simple macroscopic characters, referring to Putra et al., (2018). Macroscopic identification parameters including how to grow, fruit body shape, hygrophnous, cap color when young and old, cap diameter, upper and lower shape of cap, cap surface, cap edge, cap margin, wetness level, himenophore type (lamellae, pores, teeth) including how to attach to the stipe, length, distance between rows, and margins.

Other characters observed were stipe shape, stipe color (young and mature stage), stipe diameter and length, stipe surface, attachment position, stipe attachment type on the substrate, stipe cross-section, partial veil and universal veil, fruit body texture, odor, taste, and information on its use as food (edible or nonedible) through interviews with key persons and literature studies to obtain data related to the use of fungi. Mushroom samples identified using several identification references, including Arora.D (1986), McKnight & McKnight (1998), Largent & Stuntz (1986), Lincoff (1981).

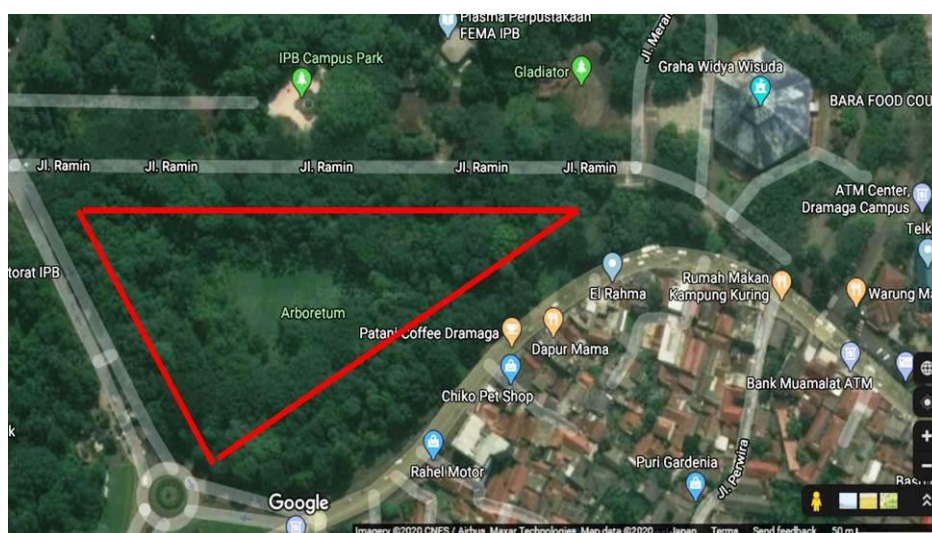


Figure 1. Sampling site (red line) of macroscopic fungi in this study

3. Results and Discussion

A total of 11 mushroom samples were identified and described in this study. The fungi are divided into 4 Orders and consist of 7 Families (Table 1). All mushrooms found were Basidiomycota, namely: *Termitomyces* sp. 1, *Termitomyces* sp. 2, *Marasmius* sp. 1, *Marasmius* sp. 2, *Psathyrella* sp., *Geastrum* sp., *Stereum* sp., *Microporus* sp., *Polyporus* sp., *Ganoderma* sp. 1 and *Ganoderma* sp. 2.

Table 1. Mushroom Diversity at IPB University Campus Forest

Phylum	Class	Order	Family	Species
Basidiomycota	Agaricomycetes	Agaricales	Lyophyllaceae	<i>Termitomyces</i> sp. 1
				<i>Termitomyces</i> sp. 2
			Marasmiaceae	<i>Marasmius</i> sp. 1
		Gastrales		<i>Marasmius</i> sp. 2
			Psathyrellaceae	<i>Psathyrella</i> sp.
			Gastraceae	<i>Geastrum</i> sp.
			Russulales	<i>Stereum</i> sp.
			Polyporales	<i>Microporus</i> sp.
				<i>Polyporus</i> sp.
			Ganodermataceae	<i>Ganoderma</i> sp. 1
				<i>Ganoderma</i> sp. 2

All mushrooms found in this study were Basidiomycota. According to [Al Ulya et al. \(2017\)](#), Basidiomycota is easier to find because it has a high amount of diversity, and is widely used as food and medicine for humans. [Putra et al., \(2019; 2018; 2017\)](#) reported that Basidiomycota plays an essential role as decomposer both in a natural and human-made ecosystem. All mushrooms found in this study are used as mycology course learning materials and samples for subsequent research. The Basidiomycota found in this study are Agaricomycetes, which divided into 4 orders and 7 families (Table 1). The mushroom found was dominated by the order of Agaricales (3 Family) and Poryporales (2 Family).

According to [Nasution et al. \(2018\)](#) Agaricales had the most number of mushrooms found in this study. Agaricales are a group of mushroom which have an umbrella-like shape and are also the most commonly found in various studies in different regions ([Tampubolona et al., 2013](#)). Members of the Agaricales are always emerged and have the largest number, which often found in various studies. Agaricales family found there were Lyophyllaceae, Marasmiaceae, and Psathyrellaceae. The Poryporales described in this study consists of two families, namely Polyporaceae and Ganodermataceae. All polyporales found to grow on decayed wood. The type of fungi that grows on dead wood generally utilizes organic material from dead organisms (saprotroph). Each mushroom found in this research has different characteristics. The following are a description of the mushroom of IPBUCF and its characters.

***Ganoderma* sp. 1**

Ganoderma sp. 1 grows in groups with close proximity (gregarious) in the decayed tree trunk. This mushroom has the shape of a fan with a shiny black color (Figure 2a) with white color on the edge of the pileus (Figure 2b). *Ganoderma* sp. 1 has a pore-shaped type of hymenophore (Figure 2c) and attaches to a pseudostipe (substipitate). The surface is smooth, with 10 cm in diameter and 0.5 to 2 cm of the thickness (Figure 2d). *Ganoderma* sp. 1 has flat edges type and dry wetness levels. This mushroom has a type of strong pore attachment and round in shape. The texture is hard, and it smells like wood.



Figure 2. Characteristics of macroscopic identification of *Ganoderma* sp. 1

***Ganoderma* sp. 2**

Ganoderma sp. 2 also grows in groups with close proximity (gregarious) in the decayed tree trunk. This mushroom has a fan-like shape with mild brown color and a white line on the edge of the pileus (Figure 3a). *Ganoderma* sp. 2 has white color at the underside, pore-shaped hymenophore (Figure 3b), and has no stipe by attaching directly to the substrate (sessile) (Figure 3c). The surface has a prominent stripe pattern, 8 cm in diameter with a flat edge (entire), and dry in wetness level. *Ganoderma* sp. 2 has pore sticking type, which strongly attached and round in shape. The body texture is hard and smells like wood.



Figure 3. Characteristics of macroscopic identification of *Ganoderma* sp. 2

The Ganodermataceae found it was identified as 2 species of *Ganoderma* in two near locations. *Ganoderma* usually grows on trees that are still alive and act as a pathogen in plants. However, all *Ganoderma* sp. found in this study grew on dead wood, so it had an important role as a decomposer. The information found about this macro fungus in Indonesia is as a cause of base rot of plant stems (Susanto et al., 2013). Even

so, several types of *Ganoderma* were previously reported to have Anti-cervical cancer, prostate cancer, lung cancer, and liver cancer (Ayeka, 2018; Tamilselvan & Rajesh, 2019; Yalcin et al., 2019).

The Polyporaceae found consisted of two species, namely *Microporus* sp. and *Polyporus* sp. Both species were found to grow on rotted wood. According to Annissa et al. (2017), Polyporaceae is an important decomposer in the natural ecosystem. Polyporaceae has the characteristics of a fan-shaped fruit body with pore type of hymenophore in the form of small holes called pores or its modification.

***Microporus* sp.**

Microporus sp. found solitary growing on decayed wood branches (Figure 4a). The mushroom has a fan-like shape fruiting body with dark brown color, pore type of hymenophore (Figure 4b), and slender pseudostipe (Figure 4c). The surface is smooth with 4.5 cm in diameter, wavy edges (undular), and dry in wetness level. *Microporus* sp. has a string attached and round-shaped pore of attachment type. The body texture is hard and odorless in smell properties. Boa (2008) and Nguyen et al. (2019) reported that several species of *Microporus* have the potential to be used as drugs.



Figure 4. Characteristics of macroscopic identification of *Polyporus* sp.

***Polyporus* sp.**

Polyporus sp. found to grow solitary on wood. The fruiting body has a pore type of hymenophore and definite stipe. The pileus is dark brown in color with 1.4 cm of diameter (Figure 5a). The shape of the pileus is flat with the velvet surface and circular pattern (Figure 5b). The lower shape of the pileus is ovoid, white in color, and crenate edge with upturned margins (Figure 5c). This fungus has a very dry fruiting body, non-detachable pore with 0.1 cm in cylinder length, and round shape. The cylindrical stipe is dark brown in color, 2 cm length, 0.2 cm in diameter, and the surface is smooth. The stipe attaches to the pileus in the central position, and the basal tomentum attaches to the substrate (Figure 5d). The stipe context is stuffed, has no distinctive odor, and sour tasted. Some *Polyporus* can be used as food, medicine, and cosmetics (Bandara et al., 2015).

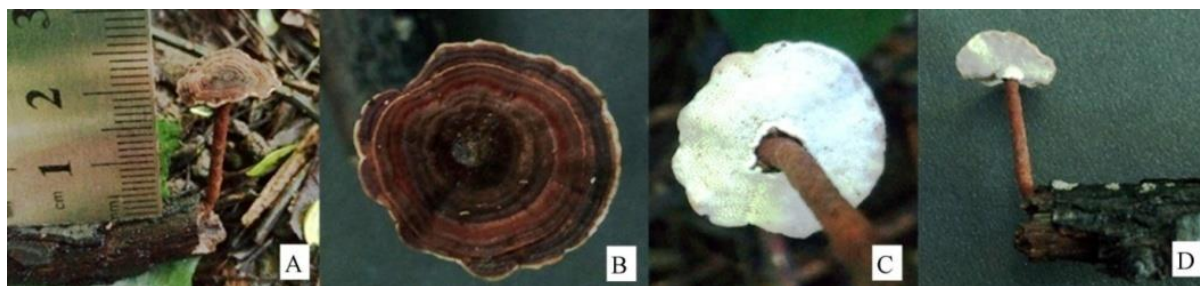


Figure 5. Characteristics of macroscopic identification of *Polyporus* sp.

The Agaricales found in this study consisted of three families, namely Lyophyllaceae, Marasmiaceae, and Patathyrellaceae. The genus of the Lyophyllaceae identified as *Termitomyces*. The two genera of *Termitomyces* were found to have an umbrella-like characteristic with a knob on the pileus. Local people consume this mushroom because of its good taste (known as 'supa bulan' in West Java and 'jamur barat' in many parts of Java Island).

***Termitomyces* sp. 1**

Termitomyces sp. 1 grows solitary in IPBUCF. The mushroom grows in termite nests with fruit body emerge above the soil. The cap is flat with lamella (a type of hymnophore) and fleshy fruit body texture (Figure 6a). Pileus color is gray to brown with a prominent peak (umbonate) (Figure 6b). *Termitomyces* sp. 1 is 15 cm in diameter. The surface of the pileus is smooth with wavy edges (undular), margin incurved, and the level of wetness is moist. The lamella is free in type attachment, white-colored, and the distance between the lines is crowded (Figure 6c). *Termitomyces* sp. 1 has a pseudorrhiza-shaped, solid, and white-colored stipe of unknown length because it extends into the ground (determined by the depth of the termite nest). The position of stipe attachment on the pileus is central, the stipe type of attachment is directly embedded in the substrate (basal tomentum), and the body texture is slightly soft. *Termitomyces* sp. 1 smells like meat and can be consumed.



Figure 6. Characteristics of macroscopic identification of *Termitomyces* sp. 1

***Termitomyces* sp. 2**

Termitomyces sp. 2 grow solitary in IPBUCF. The mushroom grows in termite nests with fruit bodies emerge above the soil. The cap is flat with lamella (a type of

hymnophore) and fleshy fruit body texture (Figure 7a). Pileus color is dominant of white color with a light brown and umbonate shaped in the middle of the cap (Figure 7b). *Termitomyces* sp. 2 pileus is 6 cm in diameter. The surface of the pileus is smooth with wavy edges (undular), margin incurved, and the level of wetness is moist. The lamella is free in type attachment, white-colored, and the distance between the lines is crowded (Figure 7d). *Termitomyces* sp. 2 has pseudorrhiza-shaped, solid, and white-colored stripe (Figure 7c) of unknown length because it extends into the ground (determined by the depth of the termite nest). The position of stipe attachment on the pileus is central, the stipe type of attachment is directly embedded in the substrate (basal tomentum), and the body texture is slightly soft. *Termitomyces* sp. 1 smells like wet soil and can be consumed.



Figure 7. Characteristics of macroscopic identification of *Termitomyces* sp. 2

To date, *Termitomyces* has not yet been able to be cultivated, and it is known as the symbiotic partner of termites. According to (Tibuhwa, 2012), termites providing certain substrate for *Termitomyces* development while the fungi produce small nodules as a food source for termites. During the rainy season with high humidity, the fungus can form a fruiting body and penetrate termite nests to the surface of the soil. Ugbogu et al (2018); Li et al. (2019); Devender and Anand (2019) reported that *Termitomyces* contains bioactive compounds such as glucose, amino acids, phenolic components, saponins, flavonoids, tannins, alkaloids, steroids, ascorbic acid, and terpenoids which are good for dealing with malnutrition in the world. The next family is Marasmiaceae, which is represented by two species, namely *Marasmius* sp. 1 and *Marasmius* sp. 2. Both of these mushrooms are found in decomposed litter and live in groups with a wide distribution in the IPBUCF.

***Marasmius* sp. 1**

Marasmius sp.1 found to grow solitary in the litter forest of IPBUCF. The fruiting body of *Marasmius* sp.1 is a cap with lamella and stipe (Figure 8a). The cap color is light brown and 1.3 cm in diameter. The shape of the pileus is flat with a fibrous surface, ovoid-shaped at the undernet, entire type of edge, straight margins, and has a moist type of the wetness level (Figure 8b). Lamella was adnexed to the stipe with a length of 0.5 cm. The distance between lines is crowded with a flat margin. The cylindric-shaped stipe (Figure 8c) color is light brown with 0.1 cm in diameter and 3 cm in length.

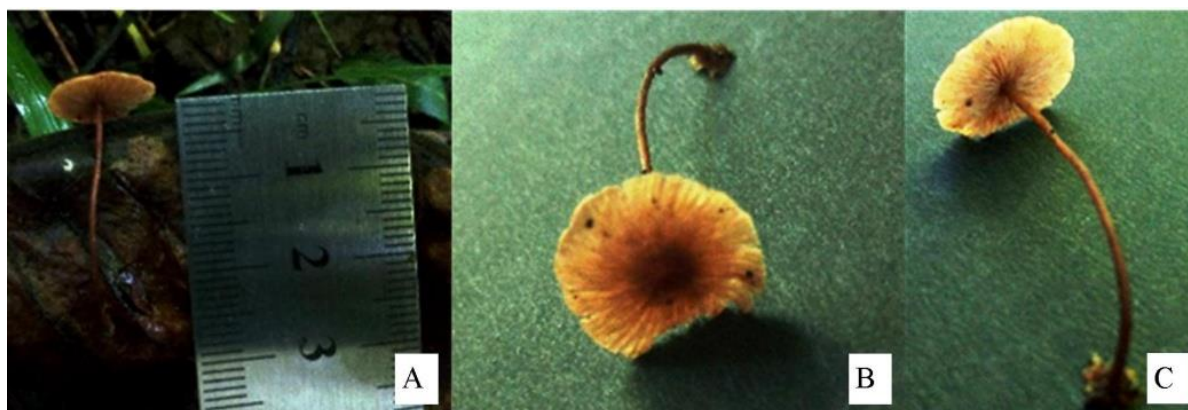


Figure 8. Characteristics of macroscopic identification of *Marasmius* sp.1

***Marasmius* sp. 2**

Marasmius sp. 2 found to grow solitary on dead wood. *Marasmius* sp. 2 has a cap with lamella and stipe (Figure 9a). Fruit body color is brownish to orange in a mature stage. The cap diameter is 0.8 cm with arched to semi globe and ovoid-shaped at the bottom. Pileus surface is smooth with indented edges and straight margins. The wetness level is dry, and the hymenophore attached to the stipe freely. The lamellae margins are slightly serrated (Figure 9b). The stipe is 3.5 cm in length and tapered downward shaped at the bottom. The stipe color is brownish to orange and smooth at the surface. The stipe attachment position to the pileus is center and directly attached to the substrate (basal tomentum). The flesh of the stipe is hollow (Figure 9c). The fruit body is soft with a distinctive odor and has a bland taste.



Figure 9. Characteristics of macroscopic identification of *Marasmius* sp.2

Marasmius can be found easily on the forest floor and has a wide distribution with diverse species, especially in tropical areas. According to Putra et al. (2017), *Marasmius* has an important role in the decomposition and nutrient cycle in Ujung Kulon National Park, Indonesia. Reports of the diversity, description, and distribution of *Marasmius* in Indonesia are still limited. One comprehensive report on *Marasmius* is the work of Desjardin et al (2000), which successfully described 37 species of *Marasmius* from Java and Bali, and 12 of them are new species. Tamur et al (2019) reported that *M. palmivorus*, which may act as a bioherbicidal and could be used as bioagent against various phytopathogenic fungi.

The Psathyrellaceae collected in this study represented by *Psathyrella* sp. This genus is distinguished from other groups of Agaricales based on its dark spore mass and fragile pileus (*Psathyros* = fragile).

***Psathyrella* sp.**

Psathyrella sp. growing solitary on the soil of IPBUCF. The fruit body is consists of a pileus with lamella and definite stipe (Figure 10a). The characteristic of the cap is dark brown with orange color in the middle part of the pileus (Figure 10b). The color changed after minutes (hygrophnous) and became light black. The cap diameter is 3 cm with semi globose shape at the top and round form underside. The pileus surface is smooth with entire edges, straight margins, and moist type of wetness level. *Psathyrella* sp. has cylindrical-hollow stipe, blackish-colored with 9.5 in length cm and 0.3 cm of diameter (Figure 10c). The lamella attached to the stipe with a narrow distance (adnexed). The length of the lamella is 1.3 cm, with a distance between lines of the Lamela is crowded, and has black color. The attachment position of the stipe on the pileus is central (Figure 10d). The type of attachment is directly embedded in the substrate (basal tomentum), with a soft texture of the stipe.

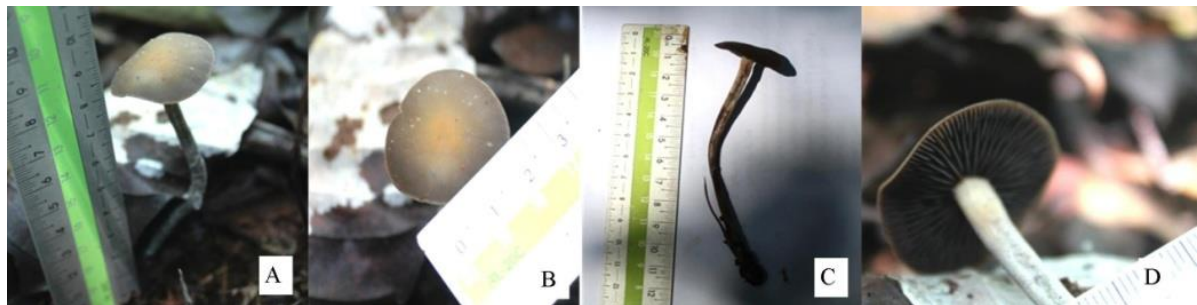


Figure 10. Characteristics of macroscopic identification of *Psathyrella* sp.

Psathyrella reported as saprotrophic fungi in the Mount Halimun Salak National Park (Susan & Retnowati, 2018) and Kepulauan Seribu (Noverita et al., 2019). Some of *Psathyrella* is used as food and source of secondary metabolites, which have important anti-microbial activity in the world Nieves-rivera (2001); Stadler et al., (2005); Suay et al., (2000); Ueda et al. (2002). However, other researchers reported that *Psathyrella* is considered as toxic mushroom Darwis, et al (2011); Priskila et al., (2018); Eraslan and Güler (2017) reported that *Psathyrella Condolleana* and *Psathyrella Spadiceogrisea* have antifungal activity against *Aspergillus* spp.

***Geastrum* sp.**

Members of the Geastrales found were *Geastrum* sp. Which also known as earthstar or 'bintang bumi' in the Indonesian language. *Geastrum* sp. found in the IPBUCF grows in groups, and the distance of the fruit body is very close (caespitose). Some of the fruit bodies also grow solitary (Figure 11a). *Geastrum* sp. has a protective structure composed of some layers called peridium. The Hymenophore type of this

mushroom is gleba. The overall size of the *Geastrum* sp. is 1-3 cm, and the fruit body is round with 0.5 cm in diameter. The peridium color is light brown to white, and the center part of the fruit body is darker with a hole in the middle for spores to release (Figure 11b).



Figure 11. Characteristics of macroscopic identification of *Geastrum* sp.

Karun & Sridhar (2014) stated that some species of *Geastrum* are ectomycorrhizae. However, *Geastrum* sp. found in this study grew on dead leaves (litter) and was not found attached to the plant roots (ectomycorrhizal characteristic). According to Verma et al. (2018), several types of *Geastrum* are found in the accumulation of humus in the forest floor and covered by a canopy, especially in the middle of the rainy season. Chittaragi et al., (2013) reported the antibacterial potency of *Geastrum triplex* jungh. against plant and human pathogens

The next order is Russulales, represented by *Stereum* sp. This fungus is found solitary colonize twigs that have been decayed. The character of this genus has a fan-like fruit body shape with pore type of hymenophore.

***Stereum* sp.**

Stereum sp. found in IPBUCF grows in groups (gregarious) on rotted tree trunks (Figure 12a). This mushroom has a fan-like shape fruit body with yellow color at the top (Figure. 12b) and white color in the opposite section (Figure 12c). *Stereum* sp. has pore-shaped hymenophore without definite stipe and attaching directly to the substrate (sessile). The surface of *Stereum* sp. has a prominent stripe pattern, 4 cm of diameter, and 1 cm of edge thickness. *Stereum* sp. poses a wavy edge (undular) with dry wetness level. The hymenophore type of *Stereum* sp. is a pore that is non-detachable with a round shape. The body texture is hard, and the fruit body smells like wood.



Figure 12. Characteristics of macroscopic identification of *Stereum* sp.

According to Priskila et al., (2018), wood or deciduous tree branches is the most common substrate for macrofungi to grow since it contains the nutritional source for mushrooms development. Several previous studies have confirmed the existence of *Stereum* in Sukabumi (Triastinurmiatiningsih et al. 2017); *Stereum* cf. *Pergameneum* which is a new record Sumatra Island (Susan & Retnowati, 2018); 3 species of *Stereum* from Kamojang, West Java Tourist Park (Arko, Marzuki, & Kusmoro, 2017); source of sterostreins (Isaka et al., 2011); antifungal activity (Aqueveque et al., 2017) and the potential of *Stereum* as drugs in the Kepulauan Seribu (Noverita et al., 2019).

Conclusion

A total of 11 species, 7 family, and 4 orders of macrofungi were successfully described from IPBUCF in this study. Fungal identification was carried out using a variety of macroscopic characters. The mushroom is *Termitomyces* sp. 1, *Termitomyces* sp. 2, *Marasmius* sp. 1, *Marasmius* sp. 2, *Psathyrella* sp., *Geastrum* sp., *Stereum* sp., *Microporus* sp., *Polyporus* sp., *Ganoderma* sp. 1 and *Ganoderma* sp. 2. Some mushrooms found to be potentially used as teaching and research materials, food source, medicine, and also played an important role as a decomposer in the IPBUCF.

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